

U.S.N. #4570687

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FIRST INTERIM REPORT ON LRS EVALUATION FIELD TESTSI. INTRODUCTION

The basic information desired in the current field tests concerns the conditions under which the LRS System will operate and those under which it will not. In a device of this type, there is no "middle ground" or marginal operation. Either operation is satisfactory or it is not.

The first phase of the field testing covered by this interrim report concerns normal operation of the equipment—that is, operation over a direct line of sight path with no intermediate objects such as walls, vehicles, or trees impeding the transmission. Investigation was primarily directed towards the determination of the effects of varying both receiver and transmitter antenna length upon system operation. As such, the first test was conducted in three parts: i) RF Radiated Field Strength at the Receiver antenna as a function of transmitter loading and antenna length. Receiver-Transmitter distance fixed. ii) Receiver detector voltage output as a function of receiver antenna length. Field Strength at the Receiver antenna fixed. iii) Receiver detector voltage required to cause reliable triggering.

II. TEST CONDITIONS, GENERAL

All tests outlined in this interrim report were conducted over a fixed transmitter-receiver distance of 440 feet. The transmission path was over relatively flat terrain, and was unimpeded by any intermediate objects. Both transmitter and receiver antennas were supported on frames constructed of wood supporting their respective antennas approximately parallel to the ground at a distance of 6 feet above the ground. Antenna length was varied, but orientation and distance above the ground were kept constant. Receivers were operated from a 110 volt 60 cycle line, but transmitters were powered by a vibrator power supply employing a 12 volt automotive battery. Voltage was monitored and kept constant by means of variacs. Photographs of the test setup were made and will be included in the final report.

III. DISCUSSION OF SPECIFIC TESTS

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A. Field Strength vs. Transmitter Antenna:

This test was conducted in two parts. In the first part, no external loading was attempted, and Field Strength was measured for Transmitter antenna lengths varying from 0 to 39 feet for all positions of the Antenna Tuning Control. The Field Strength Meter antenna was kept parallel to the Transmitter antenna throughout the test. Results of the testing are shown on the attached graph entitled Radiated Field Strength. Data for all five positions of the Tuning Control were taken, but only curves for positions 1 and 5 are shown. The plot for the other three positions falls in between these two extremes and, in general, parallels these curves.

In the second part of this test, an external pi section was placed in series with the antenna at the transmitter in the belief that complete matching could not be obtained employing only the matching network included in the transmitter itself. Results of this test are also shown on the Radiated Field Strength graph.

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Strength curve. Again, data were taken for all five positions of the Tuning Control, but only those for the first and last positions are shown.

In both of these tests, the transmitter-receiver distance was great enough to eliminate effects of the inductive field of the transmitter antenna, and similar data for other distances can be approximately computed using the inverse square law. Lesser distances would probably place the receiver within this inductive field, and would doubtless give magnitudes of field strength greater than those predicted using only the inverse square law. The tests conducted here were not to repeat those which have already been amply described in any text on Electromagnetic theory, but merely to show the efficiency of matching the LRST Transmitter with its antenna.

B. Receiver Detector Voltage vs Receiver Antenna Length:

Identical tests were conducted on two receivers—a Type "A" (White Dot) receiver, and a Type "B" (Red Dot) receiver. Six fixed field strengths were used ranging from 250 microvolts per meter to 14,000 microvolts per meter. These values were chosen to cover the complete detector voltage range for all combinations of antennas used. Field strength was measured at the receiver antenna with the field strength meter antenna parallel to the receiver antenna. Curves for the two units tested are attached and titled Sensitivity of LRST-1 Receiver vs. Antenna Length.

C. Triggering Level:

Although not strictly a field test, this measurement was made in the field in conjunction with the receiver tests described above. The triggering level for each of the two receivers is shown on the receiver sensitivity curves for each receiver.

IV. DISCUSSION OF RESULTS AND GENERAL COMMENTS:

A. Field Strength vs. Transmitter Antenna:

Two things become apparent when studying the Radiated Field Strength Curve. First, the transmitter antenna should be at least six feet in length. Increasing the length beyond this point does not give very great increase in radiated field strength. A six db gain is all that results when increasing the antenna length from six to 39 feet. Secondly, the addition of an external matching network in series with the antenna will provide approximately 7 db gain for a six foot antenna—greater gain than increasing the antenna length to 39 feet without the matching network. Preliminary interpretation of these data would seem to indicate that some effort should be made in the direction of improving the matching network provided in the transmitter.

B. Receiver Detector Voltage vs. Receiver Antenna Length:

Again two things can be determined from an inspection of these data as shown on the sensitivity curves for the two units tested. First, antenna lengths of six feet are desirable. Secondly, there is apparently a threshold of signal strength in the neighborhood of 1400 microvolts per meter below which no reasonable increase in receiver antenna strength can pull in enough signal to operate the unit. The 2800 microvolt per meter and greater intensities all gave satisfactory operation with antenna lengths of six feet or greater.

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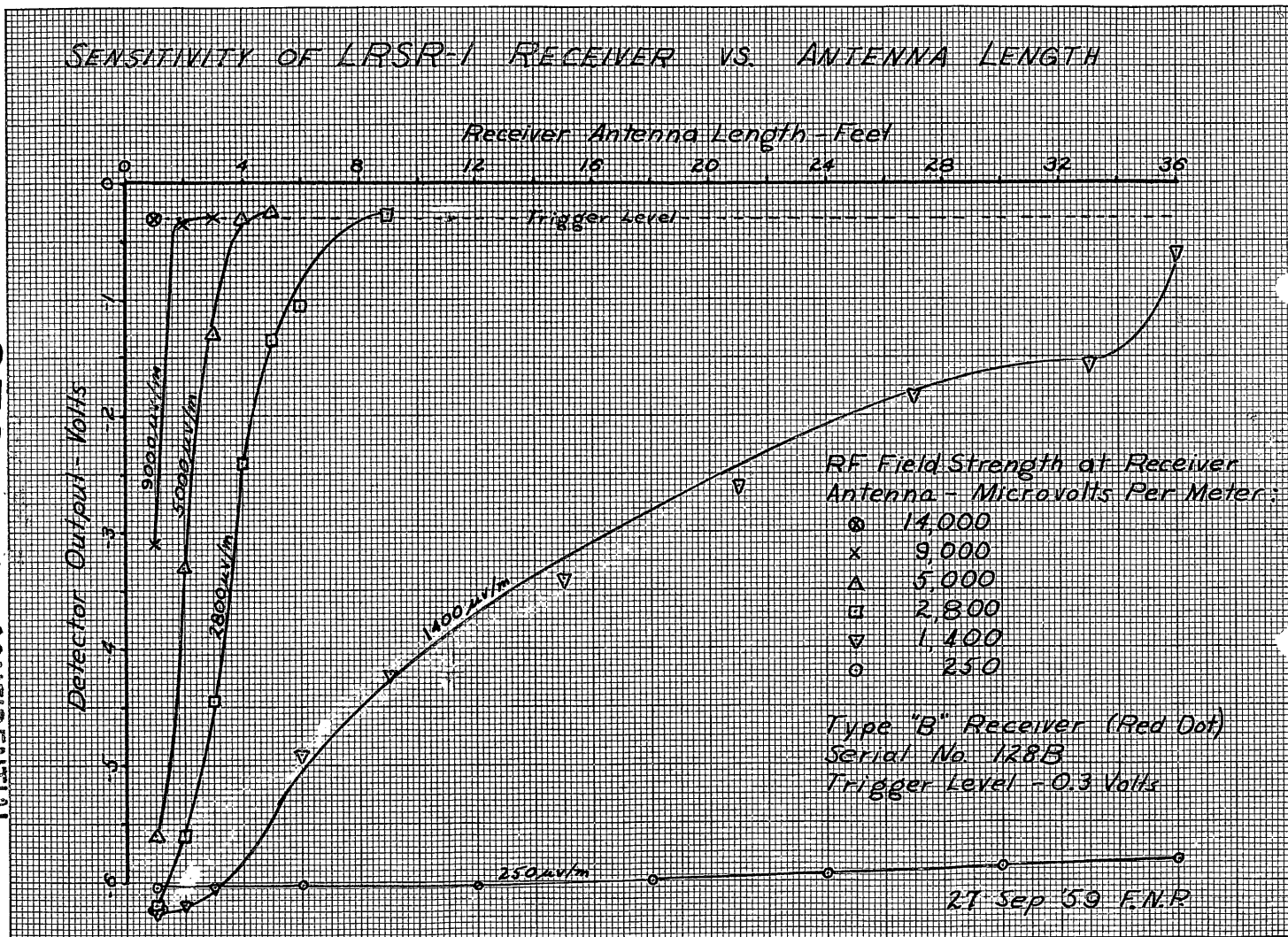
During the performance of this phase of the testing, two of the three available red dot receivers failed in such a way that adequate voltage for triggering could not be obtained from the detector even with a transmitter placed within six feet of a receiver. Since these operations are being conducted in the field, no determination has yet been made of the reason for these failures. This information is merely being passed on to provide the user with all information concerning the testing program as it develops.

C. Triggering level:

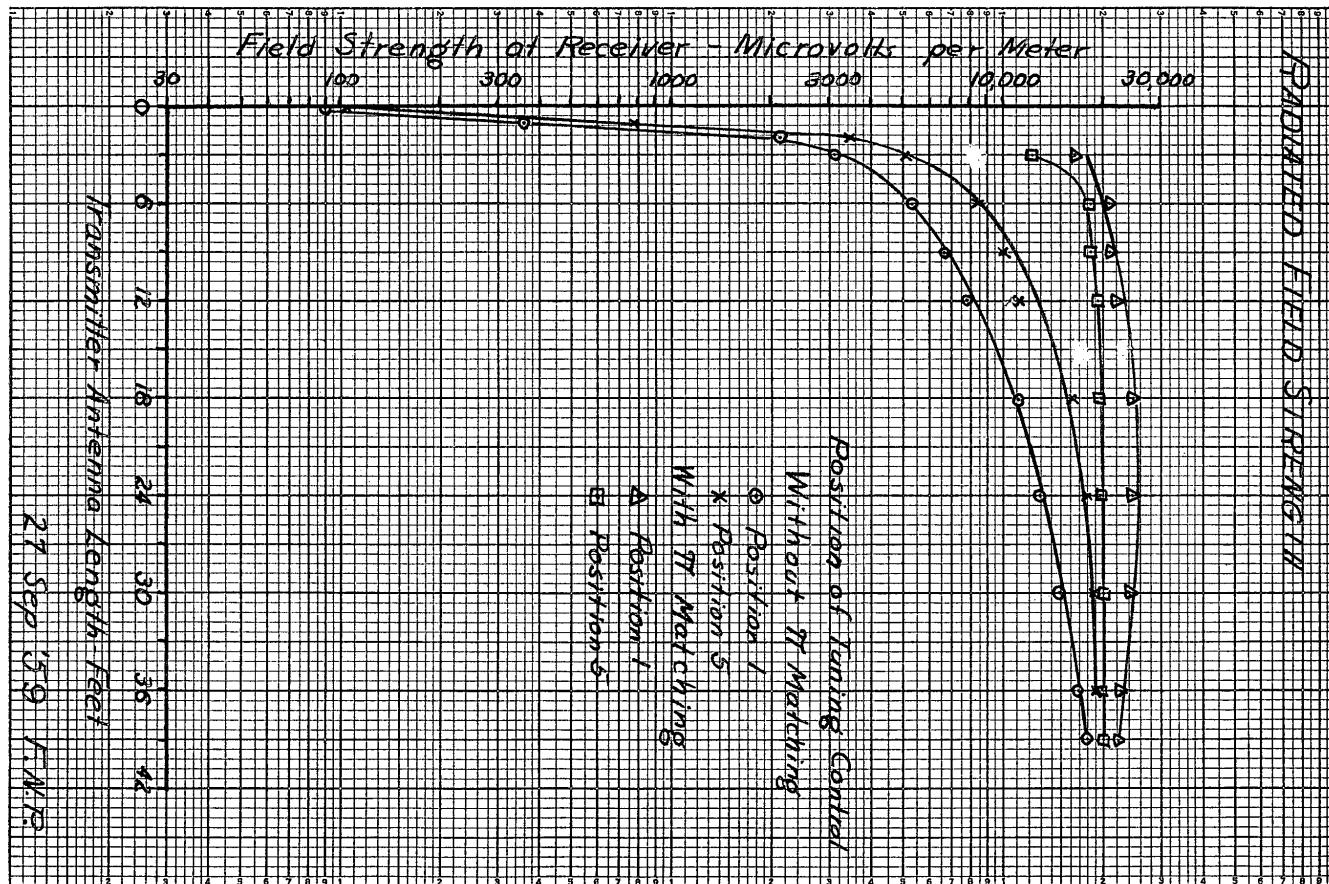
During the laboratory preparation for the field testing, measurement was made on one white dot receiver with regard to detector voltage required to gate the multivibrator and trigger the relay. This voltage was in the vicinity of 3.0 volts negative—a figure approximately half way between no signal and saturation level of the detector. However, when the units were tested in the field, it was found that the white dot units required drive to -1.1 volts for triggering, while the red dot units required drive to -0.3 volts. Since this latter figure nearly represents the saturation level, an extremely strong signal is required in order to trigger these units, and it is very likely that triggering will not occur. Naturally, it has not yet been determined why this phenomenon occurs, nor is it certain that it does occur for all red dot units, but a trend is evident in the available equipment which will come under more intensive investigation later in the program. Again, this information is presented for immediate consideration by the customer. This effect, if it is indeed typical for the red dot units, could very easily result in many failures in the field.

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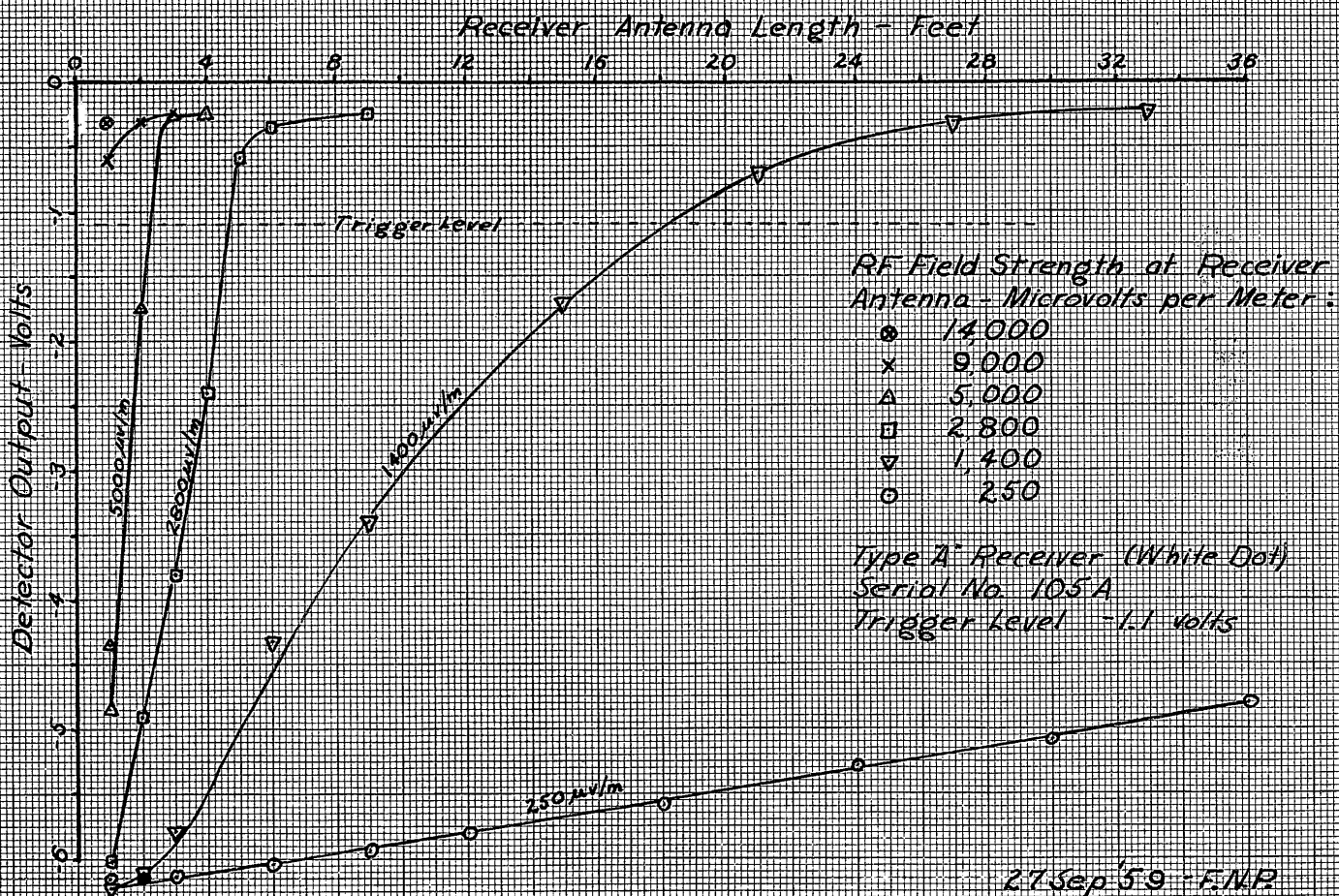
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SENSITIVITY OF LRSR-1 RECEIVER VS. ANTENNA LENGTH

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